Renewable energy markets and policies

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Renewable Energy Markets and Policies

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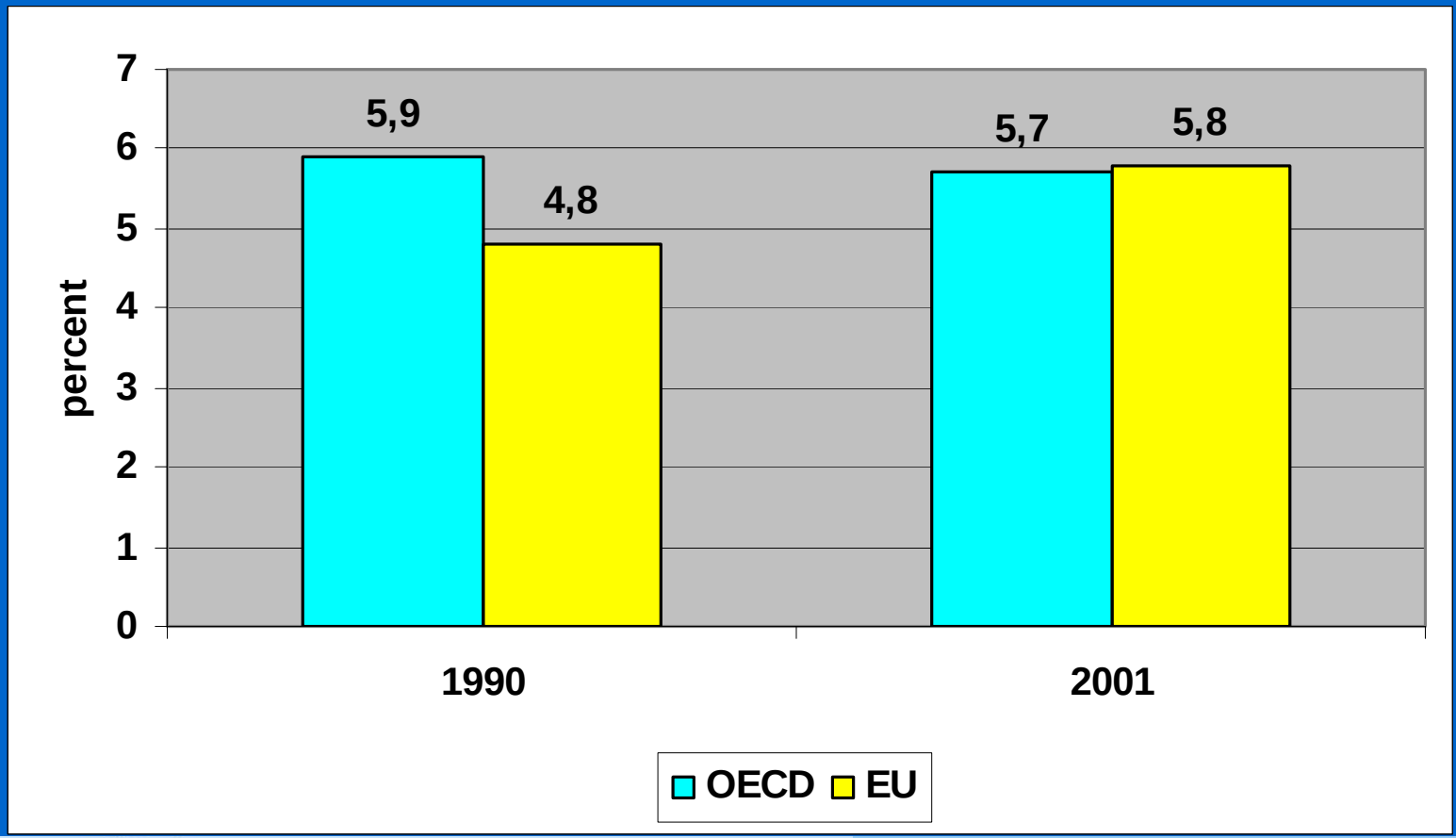
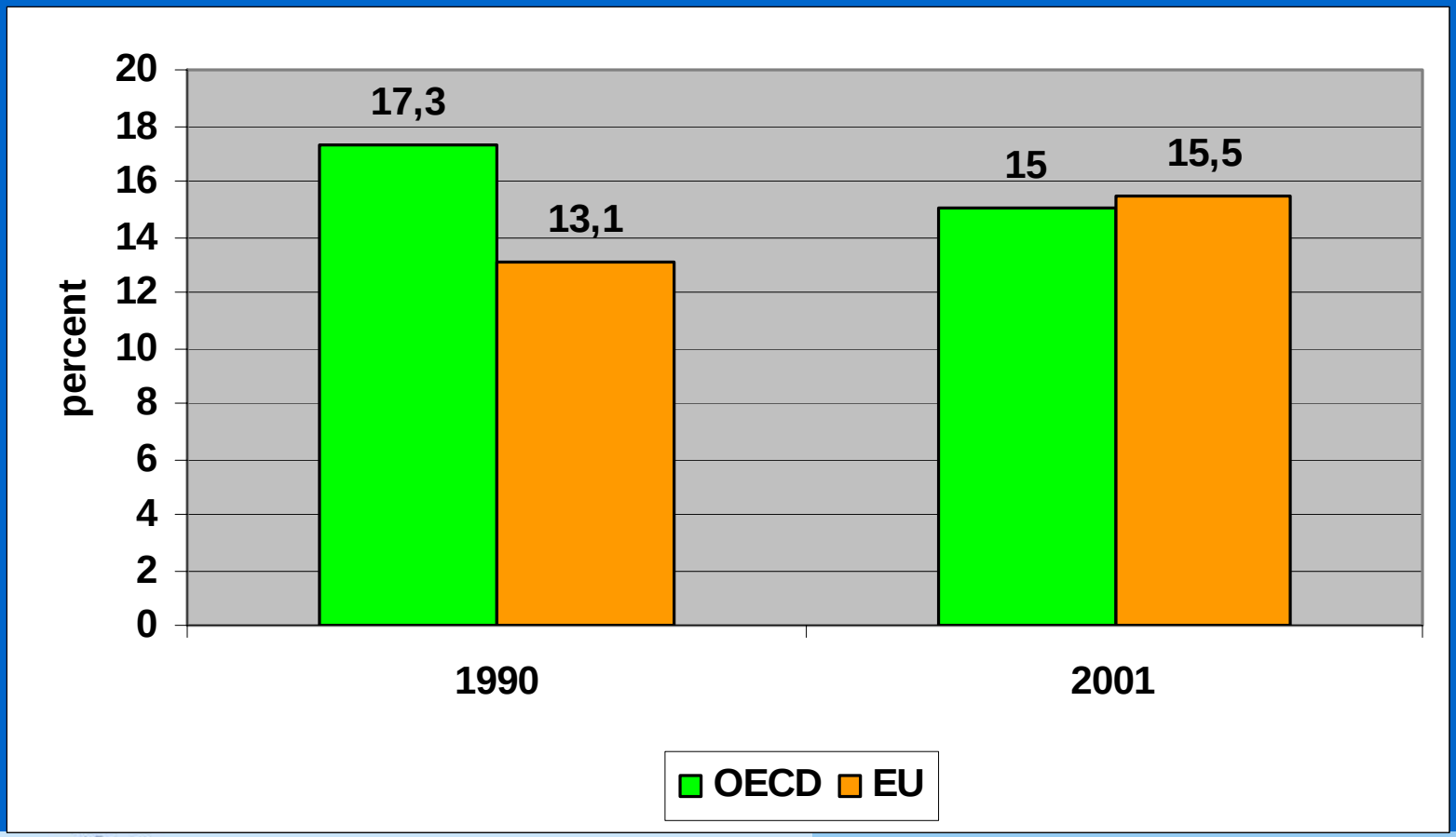
1. Renewables in Energy Supply

Share in Primary Energy Supply



1. Renewables in Energy Supply

Share in Electricity Supply

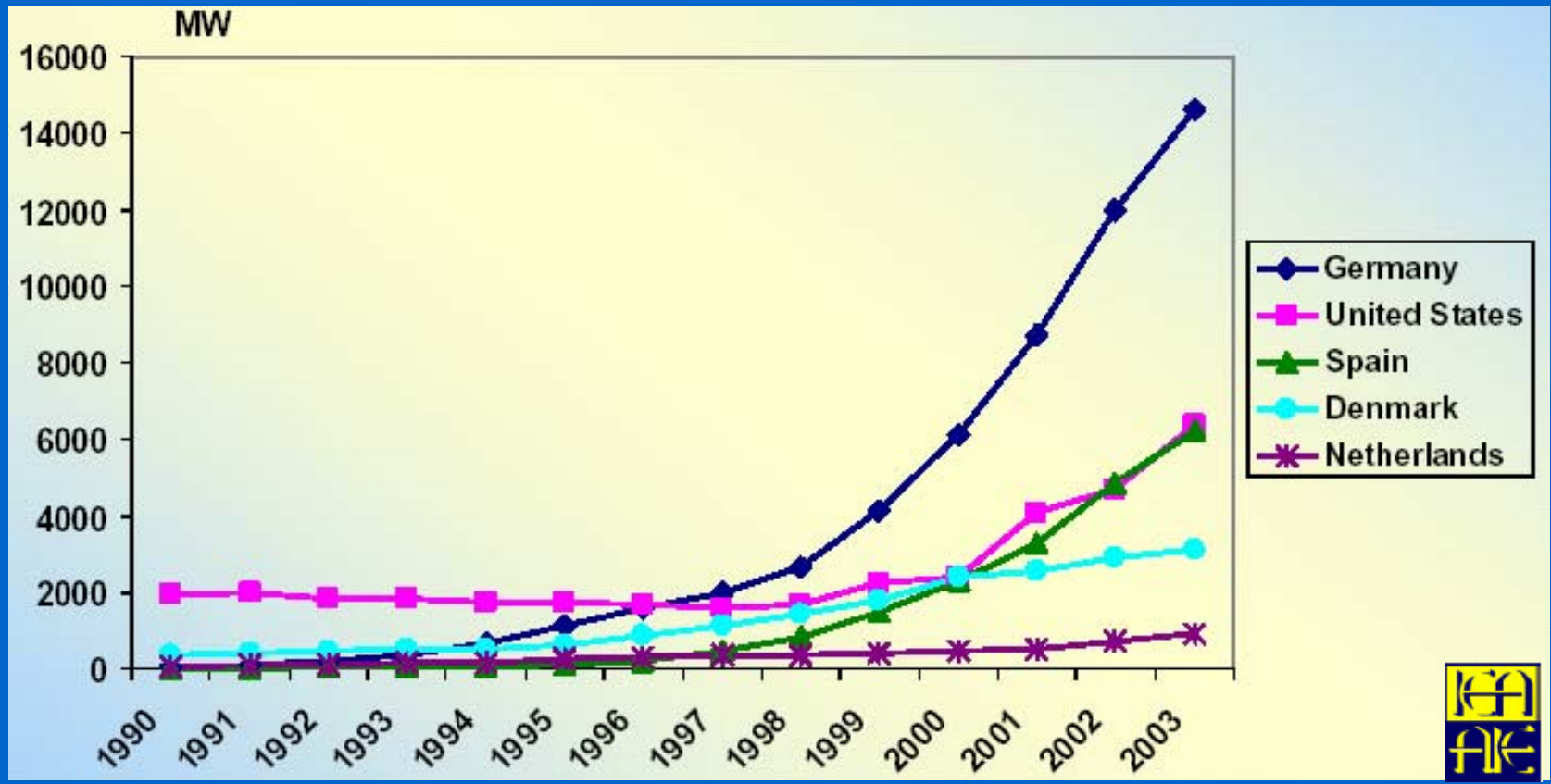


1. Renewables in Energy Supply

Average annual growth rate, OECD countries

	1970-1980	1980-1990	1990-2001
Renewables	3.2 %	2.4 %	1.2 %
Bioenergy	3.5 %	3.0 %	1.6 %
Hydro	2.6 %	0.7 %	0.4 %
Geothermal	8.3 %	9.4 %	0.4 %
Wind/Solar	6.4 %	23.5 %	23.1 %

2. Wind Energy
Installed capacity



2. Wind Energy

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Technology and costs

- Increasing rotor diameter and turbine size
  - 10 m (22-35 kW) - 1970s
  - > 80 m (5 MW) - 2004
  - 200 m (7.5 – 12 MW)
- Declining costs
  - US$0.70/kWh – 1970s
  - US$0.035-0.040/kWh – 2000s
  - Onshore – US$850-950/kW
  - Offshore – US$1100-2000/kW

Policies

- RD&D
  - RD&D investments prior to rapid market growth
  - Denmark, Germany, US
- Feed-in tariffs
  - Rapid diffusion
  - Germany, Spain, Denmark and Italy
- Production tax credits
  - US

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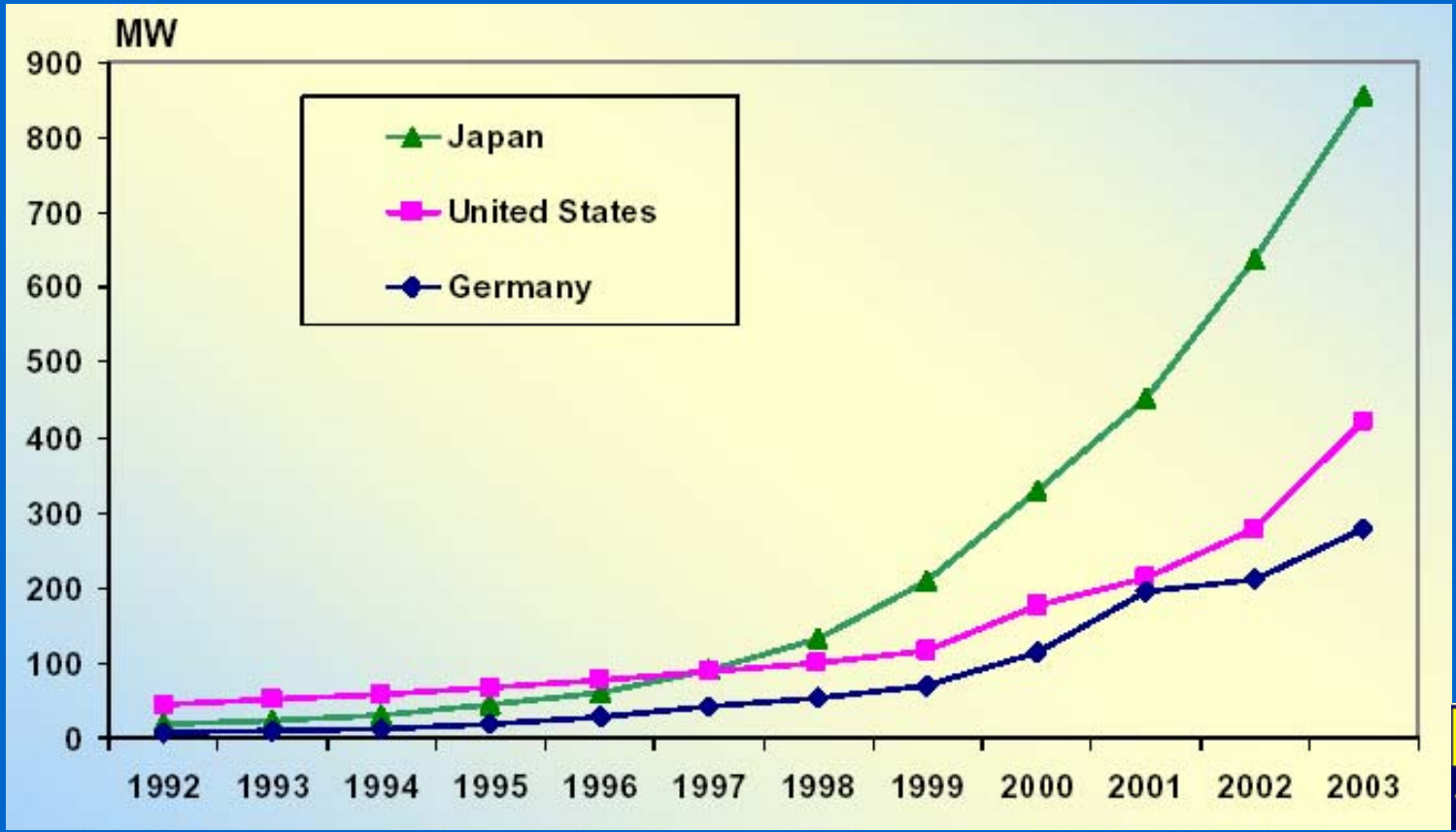
3. Solar PV
Installed capacity



3. Solar PV

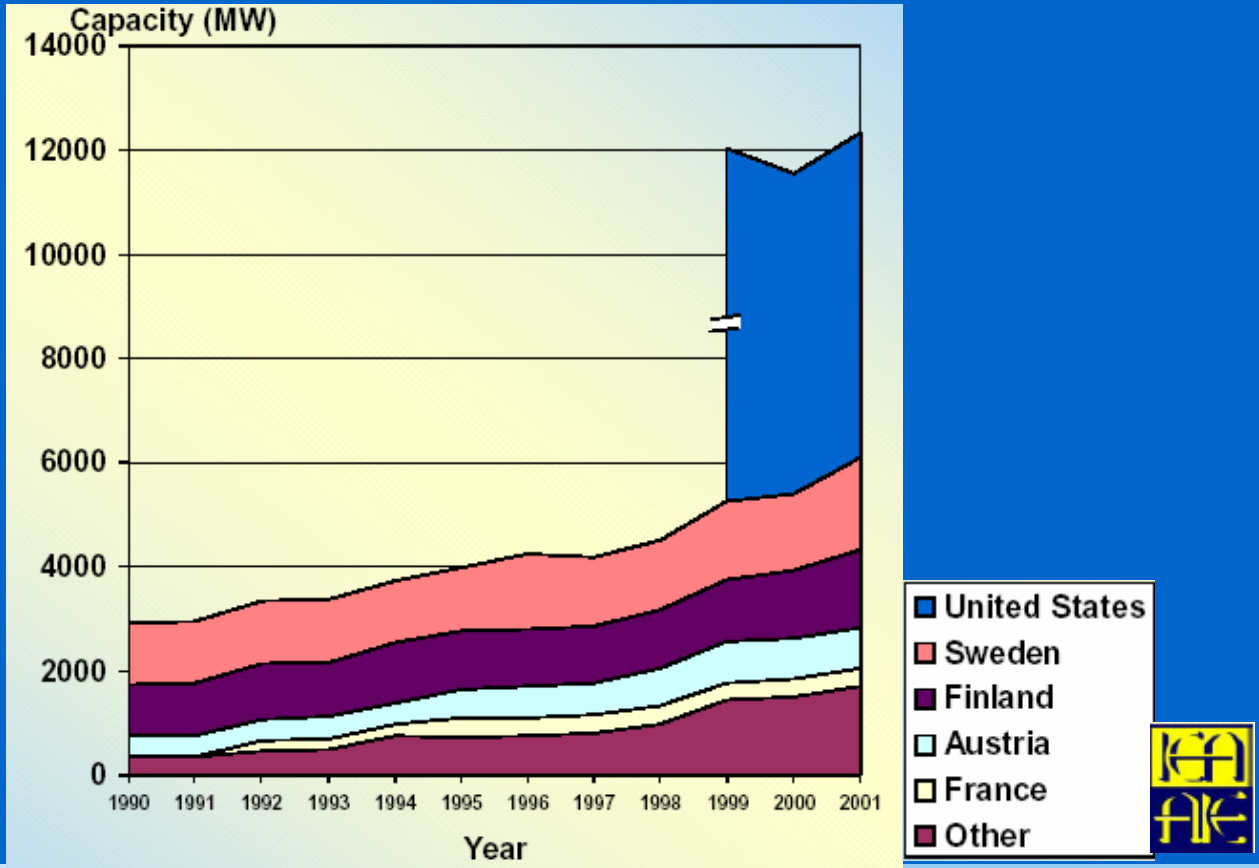
Technology and costs

- Crystalline silicon
  - more efficient and market dominant
- Thin film
  - will be less expensive in the medium and long run
- Costs
  - On-grid (BIPV) – US$5-9/W
  - Off-grid (SHS) – US$10-18/W

Policies

- Japan
  - RD&D, net metering, capital grants
- Germany
  - RD&D, feed-in tariffs, production subsidies
- US
  - RD&D, voluntary programme, net metering, cash rebates, renewable portfolio standards

4. Bioenergy
Installed capacity



5. Bioenergy
Installed capacity

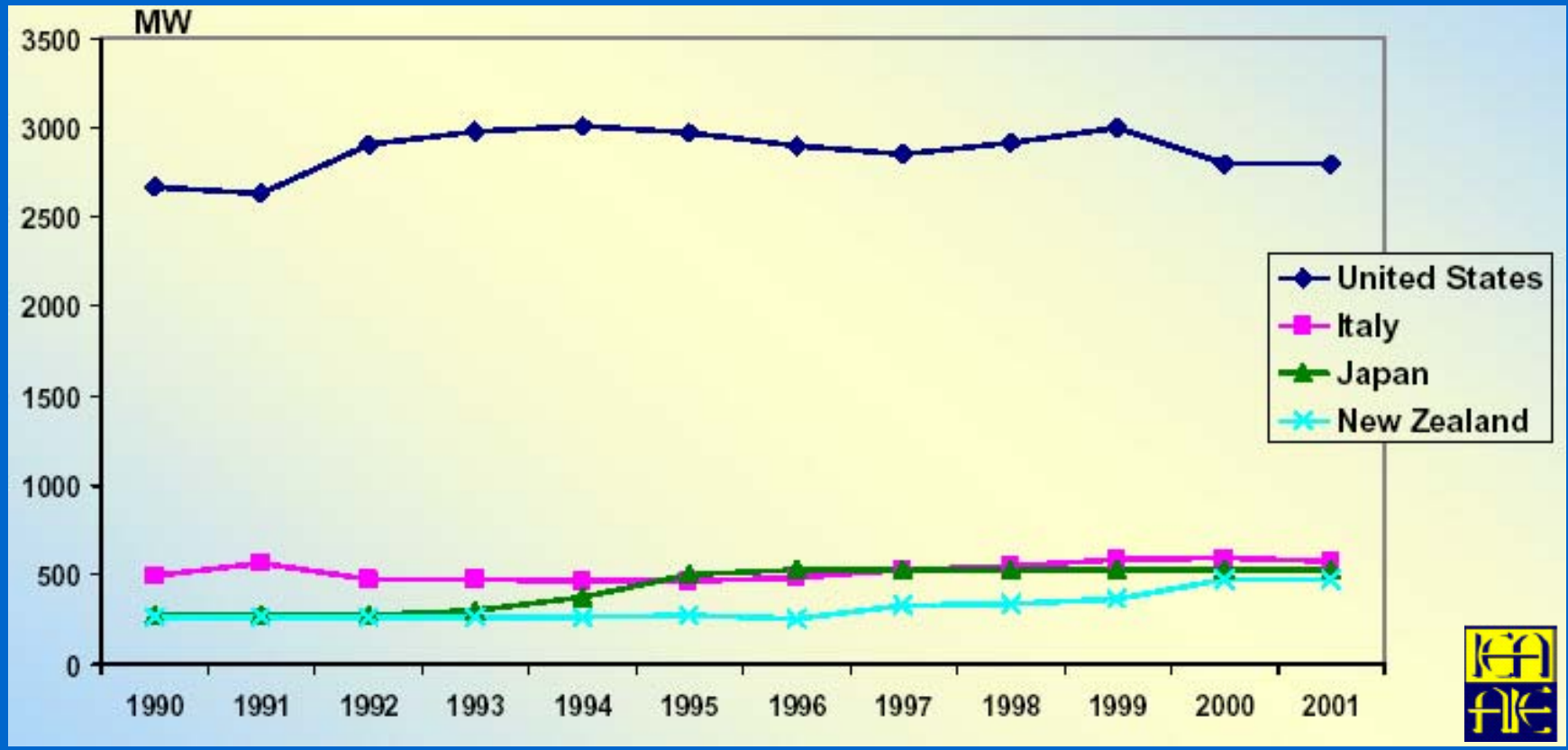
Technology and costs

- Transformation
  - Electricity generation
  - Heat generation
  - Biogas electricity generation
- Costs (solid biomass)
  - US$ 0.02/kWh – co-firing
  - US$ 0.10-0.20/kWh – direct firing

Policies

- Finland
  - Carbon tax exemption, electricity tax refund
- Sweden
  - Fuel tax exemptions
- Austria
  - Fuel tax exemptions, guaranteed tariff, capital incentives
- Portugal
  - Investment incentives

6. Geothermal
Installed capacity



6. Geothermal

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Technology and costs

- Conversion
  - Dry steam
  - Flash steam
  - Binary cycle power
- Costs (US)
  - US$ 100-400/kW (typical)
  - US$ 0.015-0.025/kWh - single flash
  - US$ 0.03-0.05/kWh – binary systems

Policies

- US
  - RD&D, mandated purchase
- Italy
  - RD&D, fed-in tariffs
- Japan
  - resource assessment funding
- New Zealand
  - RD&D

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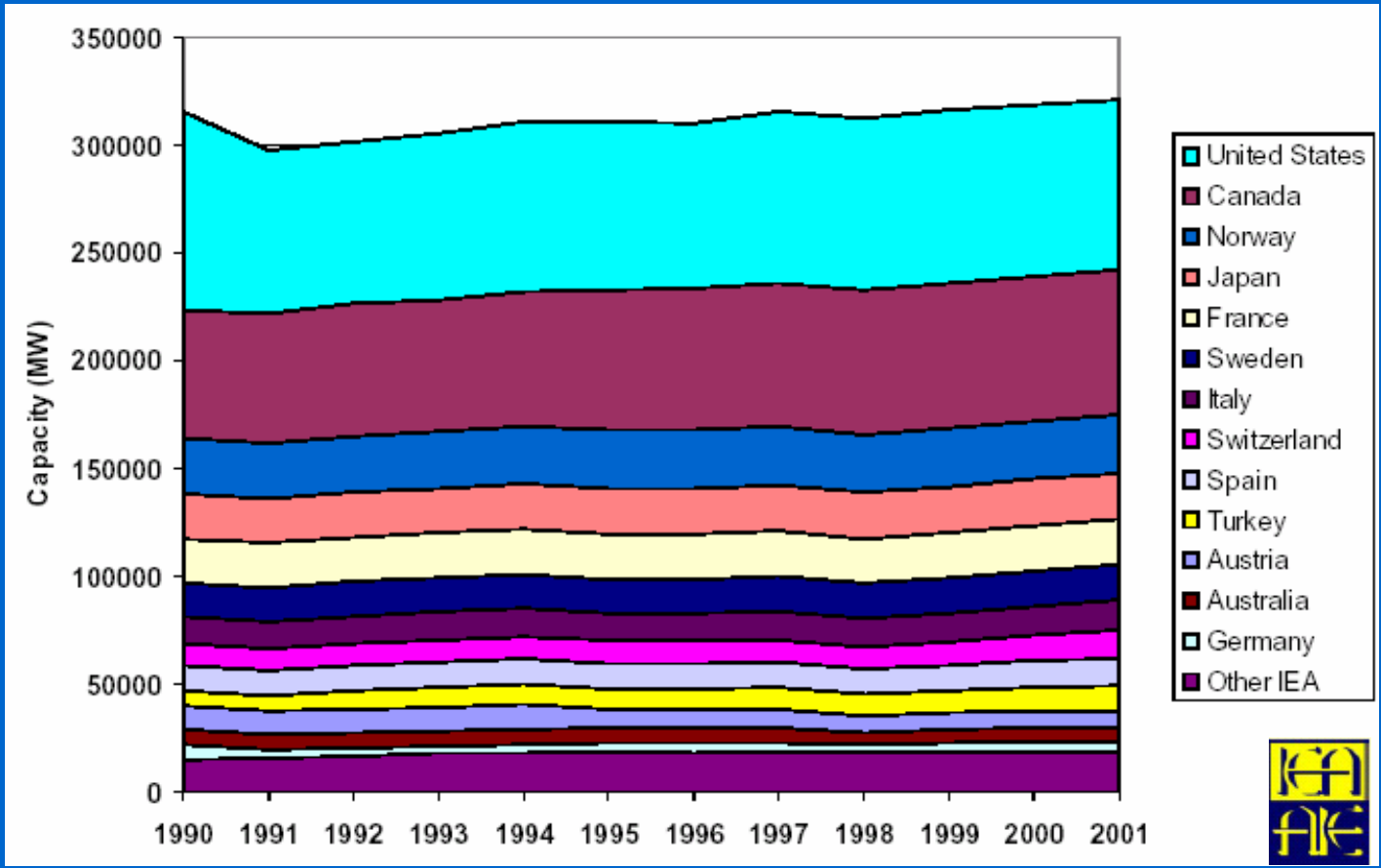
7. Hydropower
Installed capacity



7. Hydropower

Technology and costs

- Large hydro
  - Environmental and social issues
  - US$ 2,400/MW
  - US$ 0.03-0.4/kWh
- Small hydro
  - US$ 0.04-0.06/kWh

Policies

- Australia
  - Mandatory RE target
- Belgium, Germany, Ireland, Switzerland
  - feed-in tariffs
- Japan
  - Capital grants

8. Policy Drivers

- **Economic**
  - Economic optimization
  - Security of supply
  - Leading European Industry
- **Environment**
  - Reducing emissions
  - Mitigating climate change
- **Social**
  - Employment
  - Public support
  - Socio-economic cohesion
- **Shifting priorities**
  - Security – environment – climate – mixed (4Es)
- **4Es**
  - Energy security
  - Economic development
  - Environmental protection
  - Energy access

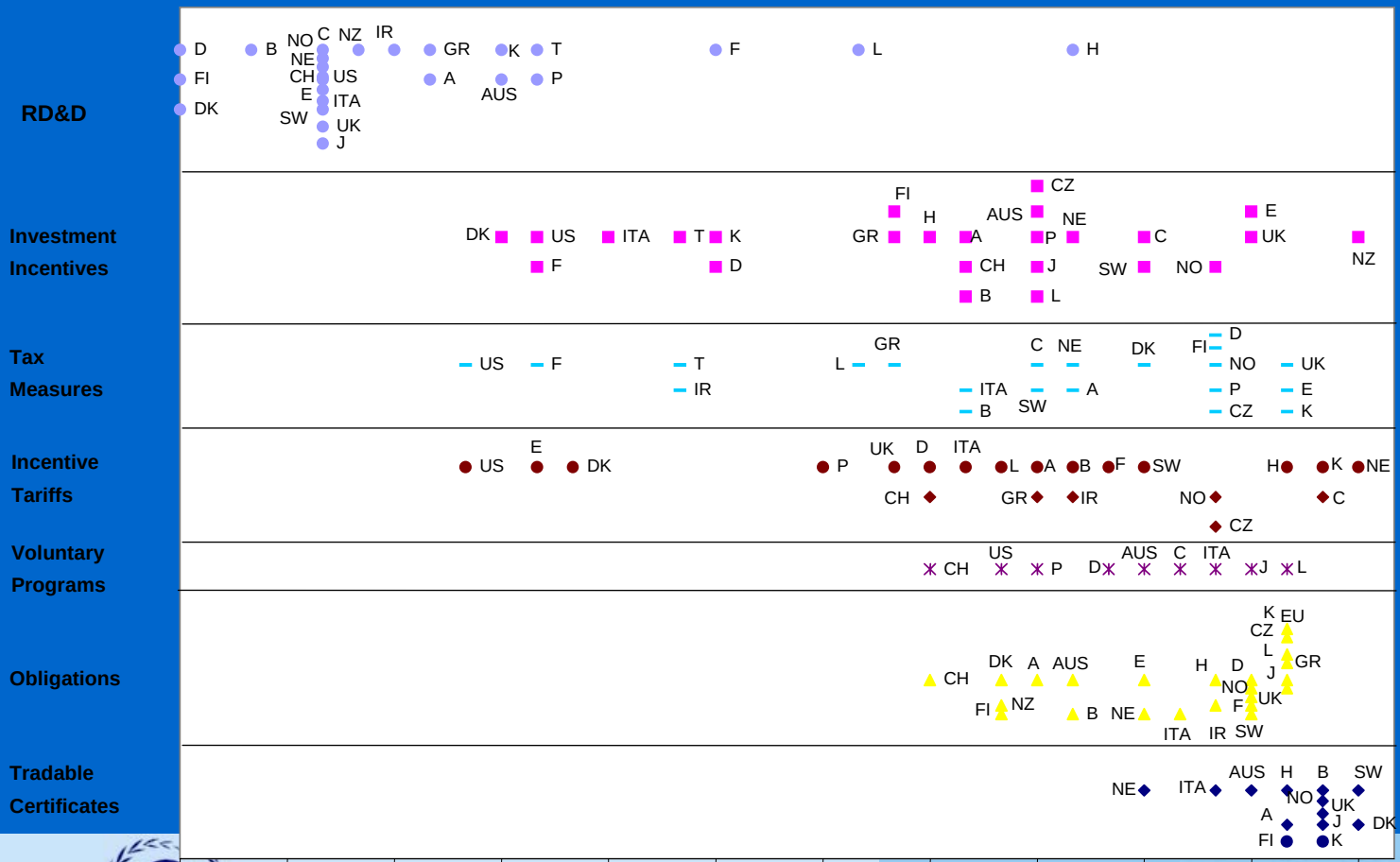
9. RE Targets

- Directive 2001/77/EC – promotion of electricity produced from RE sources
- Indicative targets (share in electricity consumption)
- EU 15
  - 13.9% in 1997 to 22% in 2010
- EU 10 (accession)
  - 5.6% in 2000 to 11% in 2010

- Though not binding – serves as catalyst in initiating political initiatives

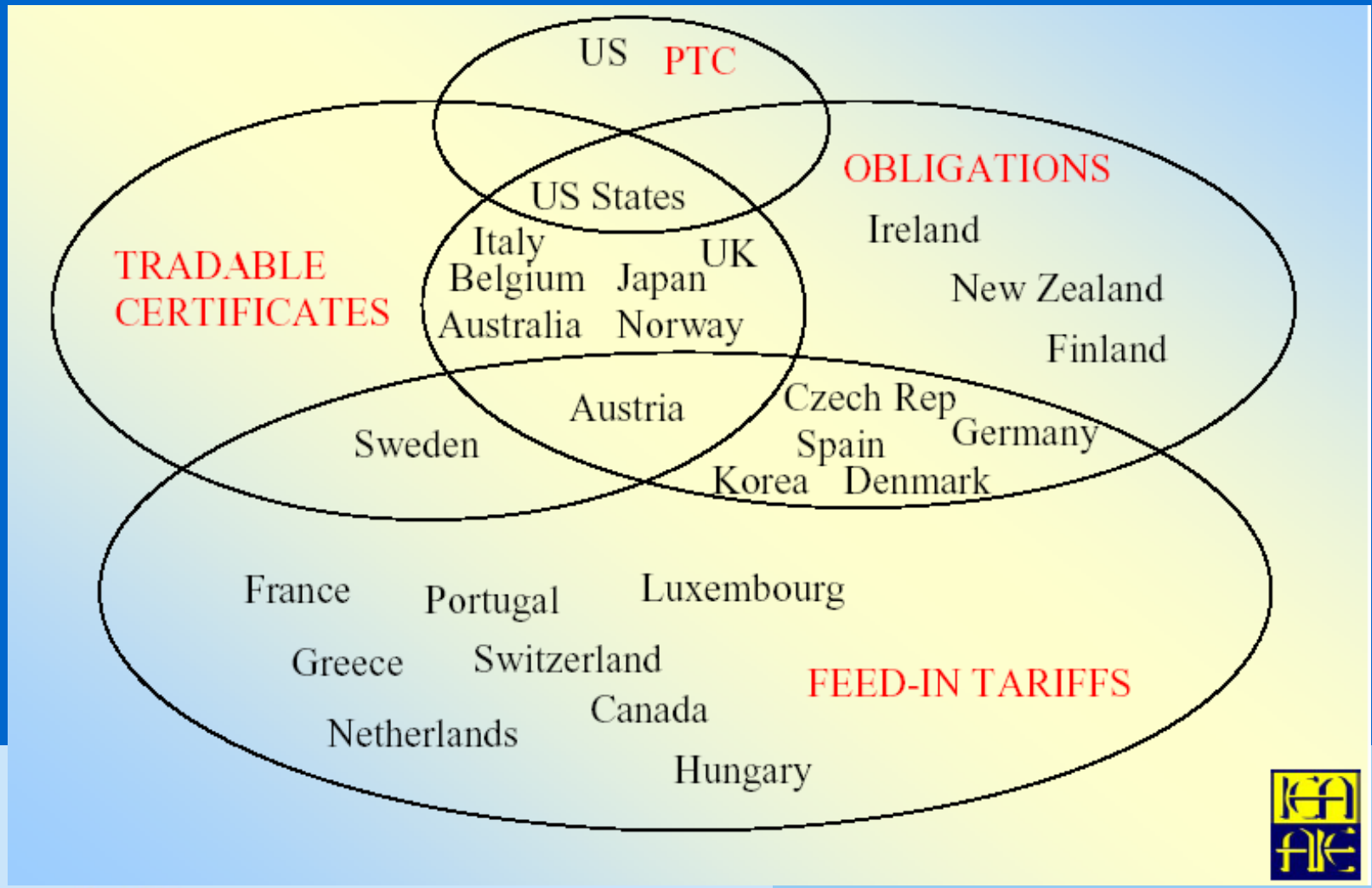
10. Policy Instruments

Evolution of Policy Instruments



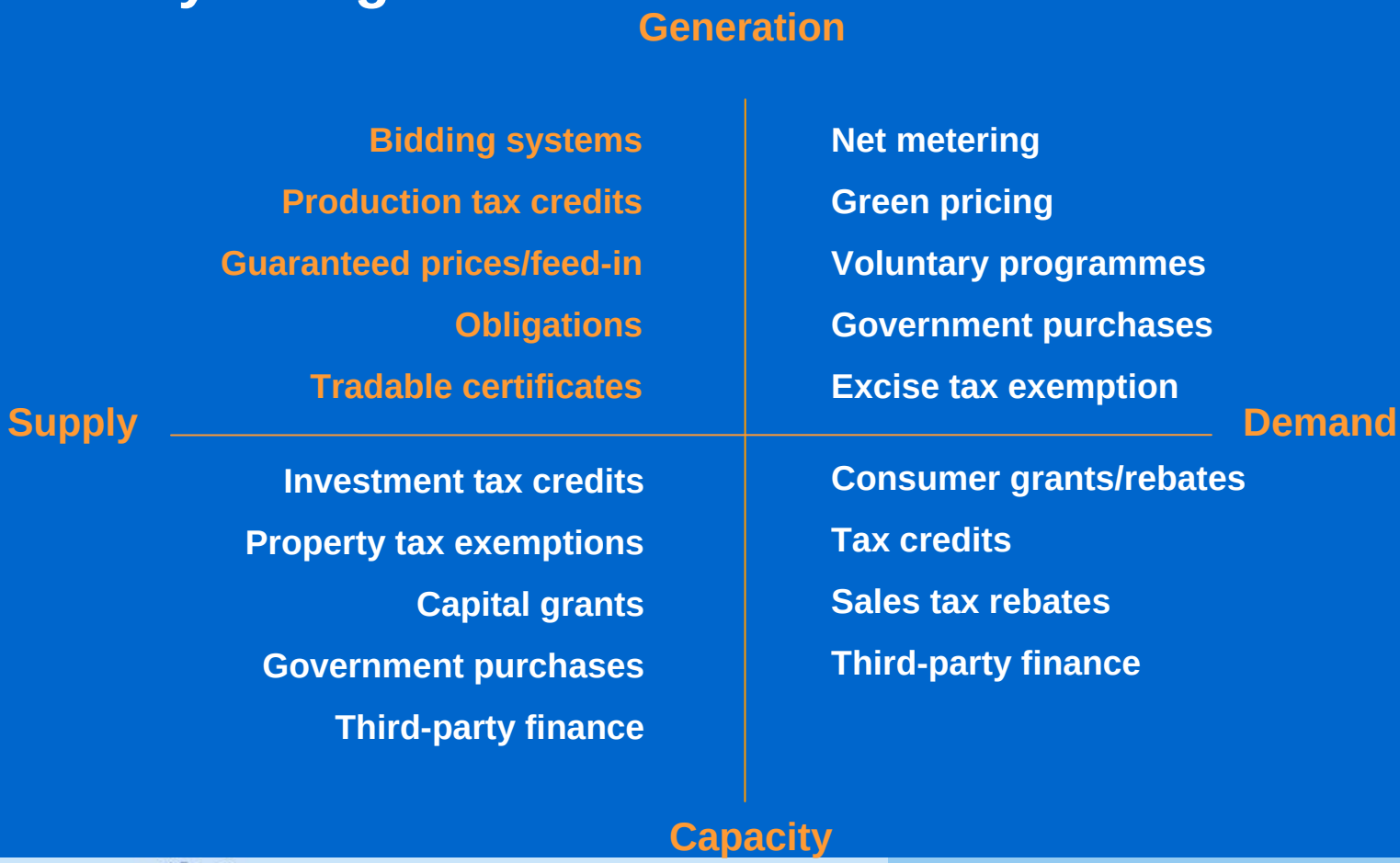
10. Policy Instruments

Key Policy Instruments



10. Policy Instruments

Policy Categories



10. Policy Instruments

Impacts: forecast capacities

	Installed Capacity 2000 GW	Installed Capacity 2010 GW (forecast)	% annual growth
Small hydropower	32	45	~ 3.5
Small PV power	1.1	11	~ 26
Concentrating solar power	0.4	2	~ 17.5
Biopower	37	55	~ 4
Geothermal power	8	14	~ 5.5
Wind power	17	130	~ 22.5

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11. RE Market Deployment

- **Policies**
  - From RD&D policies to Market Deployment policies
  - Market deployment
    - Investment incentives, tax measures (supply-capacity category)
    - Feed-in tariffs, obligations, tradable certificates (supply-generation)
- **Combination of policies**
  - Japan (PV) – RD&D, public awareness, financial incentives, grid access (net metering)
  - Spain (wind) – feed-in tariffs, low-interest loans, capital grants, support to local turbine manufacturers

11. RE Market Deployment

- **Longevity and predictability of policy support**
  - **Feed-in tariffs – Italy (8 years), Germany (20 years)**
  - **Stop and go tax credits in the US – undermine investment**
- **Role of local authorities**
  - **Spain – wind development in regions where regional governments actively support**

11. RE Market Deployment

- **Mechanisms evolved as country gain experience**
  - **Germany (feed-in tariffs) – avoided cost, modified according to industrial development**
  - **Denmark – feed-in tariff to certificate trading system**
  - **Japan – RPS, retained RD&D funding and market deployment incentives**
- **Market liberalisation**
  - **Fall of prices – price targets that renewables must meet become challenging**
  - **Quotas and RE certificates are consistent with competitive markets**